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1. AGENCY USE ONLY (Leave blank)

2. REPORT DATE

24 June 1994

3. REPORT TYPE AND DATES COVERED

First Annual Technical, 6/1/93-5/31/94

4. TITLE AND SUBTITLE

ASSERT-92 Fundamental Studies of a High Energy Molecular System: Spectroscopy of Boron in Hydrogen Clusters

5. FUNDING NUMBERS

3484/XS

6. AUTHOR(S)

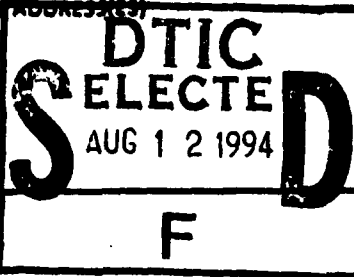
Mitchio Okumura

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

California Institute of Technology  
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REPORT NUMBER

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F49620-93-1-0326

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION / AVAILABILITY STATEMENT

APPROVED FOR PUBLIC RELEASE: DISTRIBUTION IS UNLIMITED.

12b. DISTRIBUTION CODE

13. ABSTRACT (Maximum 200 words)

The graduate student and the undergraduates supported by this AASERT award have designed and fabricated a molecular beam spectroscopy apparatus for the study of metal-hydrogen complexes. This instrument is necessary for accomplishing the tasks set out for both the parent award and the AASERT grant. The students have also aided in the design of both a novel cryogenically-cooled laser vaporization source and a second chamber, currently being fabricated, for resonant multiphoton ionization spectroscopy. They have optimized the collection of UV laser-induced fluorescence spectra using a free jet expansion of benzene, and are now beginning their first studies of metal-hydrogen systems with the prototype HEDM system Al-H<sub>2</sub>.

14. SUBJECT TERMS

15. NUMBER OF PAGES

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OF REPORT

UNCLASSIFIED

18. SECURITY CLASSIFICATION  
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20. LIMITATION OF ABSTRACT

**AASERT-92 Fundamental Studies of a High Energy Molecular System:  
Spectroscopy of Boron in Hydrogen Clusters**

**First Annual Technical Report  
June 1, 1993 to May 31, 1994  
F49620-93-1-0326**

**Approved for public release;  
distribution unlimited.**

Mitchio Okumura  
California Institute of Technology

Graduate Student

During this performance period, the graduate student currently supported by the AASERT award, Matthew S. Johnson, has worked on all phases of the development of the molecular beam-laser spectroscopy experiment. His primary responsibility was in the design, fabrication, and testing of the laser-induced fluorescence (LIF) components. This work included drafting and machining of components, developing computer interface codes, and initial testing of the electronics and light collection hardware using an existing flow cell apparatus. He has also been heavily involved in the design, construction, and testing of the molecular beam apparatus including the most critical component, the cryogenically-cooled laser vaporization source. The molecular LIF signal has been optimized using a free jet expansion of benzene, which has absorption bands close to the resonance fluorescence line of the boron atom. Matt is currently preparing to study the  $\text{Al-H}_2$  system, because aluminum doped in solid hydrogen has promise as a HEDM material, and because formation of this complex appears to pose the fewest technical problems.

Matt has received passing grades for the performance period of the AASERT award, as well as during his entire enrollment at Caltech.

Undergraduates

Gary T. Olsen, a Caltech undergraduate, worked as a summer undergraduate research fellow from June 1993 to August 1993 following the completion of his junior year. He designed and built the frame for the machine, and helped in construction and design of the vacuum chamber. He also did the preliminary design of the light collection optics for the laser-induced fluorescence experiment. Gary passed all of his classes, and graduated in June, 1994 with honors.

Mitsuo Kobayashi worked on this project as a Caltech freshman work-study student during the summer of 1993. He passed all of his coursework prior to and since his participation in this project. His primary responsibilities were to assist the graduate students in building the vacuum chamber.

**94-25446**



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## AASERT Evaluation Report

Grant No. AFOSR Grant F49620-93-1-0326

Title AASERT-92 Fundamental Studies of a High Energy Molecular System: Spectroscopy of Boron in Hydrogen Clusters

Principal Investigator: Mitchio Okumura  
Assistant Professor of Chemical Physics  
Division of Chemistry and Chemical Engineering  
Mail Code 127-72  
California Institute of Technology  
Pasadena, CA 91125

a) Parent Award: F49620-92-J-0537  
(start date: September 30, 1992)

b) Parent agreement, 12 months prior

Amount of funding for the parent agreement (year 1)	\$167,322.
Number of full-time equivalent graduate students supported	1.5

c) Parent agreement, 12 month period

Amount of funding for the parent agreement	\$172,966.
Number of full-time equivalent graduate students supported	2

d) AASERT agreement, 12 month period


6/1/93 to 5/31/94

Amount of funding provided for in the AASERT agreement	\$45,860.
Number of full-time equivalent graduate students provided for	1.
Number of undergraduates provided for	1.

e) Certification of Citizenship

I certify that the following students supported by the AASERT award are citizens of the United States of America:

Matthew S. Johnson, Mitsuo Kobayashi, and Gary T. Olsen

  
\_\_\_\_\_  
Mitchio Okumura  
Assistant Professor of Chemical Physics

6/24/94  
\_\_\_\_\_  
Date